Nesom, G.L. 2010. Taxonomy of the *Glandularia bipinnatifida* group (Verbenaceae) in the USA. Phytoneuron 2010-46: 1–20. Mailed 12 October 2010.

TAXONOMY OF THE *GLANDULARIA BIPINNATIFIDA* GROUP (VERBENACEAE) IN THE USA

GUY L. NESOM
2925 Hartwood Drive
Fort Worth, TX 76109, USA
www.guynesom.com

ABSTRACT

Study of plants variously identified within the *Glandularia bipinnatifida* group indicates that the USA entities are appropriately recognized within six species: *G. bipinnatifida* (Nutt.) Nutt., *G. wrightii* (A. Gray) Umber, *G. chiricahuensis* Umber, **Glandularia latilobata** (Perry) Nesom, comb. et stat. nov., **Glandularia longidentata** (Perry) Nesom, comb. et stat. nov., and **Glandularia pubera** (Greene) Nesom, comb. nov. These species are distinguished in a key, described, and mapped. Summaries of typification are provided. *Glandularia gooddingii* is sometimes confused with these species and its distinction is discussed.
KEY WORDS: *Glandularia bipinnatifida*, Verbenaceae, taxonomy

The taxonomy of *Glandularia bipinnatifida* (Nutt.) Nutt. and its close relatives has been studied by Perry (1933), Moldenke (1962–1965), Umber (1979, 1980), Turner (1998, 1999), and Turner and Powell (2005) but identification of these plants has remained problematic. In connection with the development of an overview and taxonomic treatment for the Flora of North America North of Mexico (FNANM), I have reviewed the nomenclatural types and variation patterns in these plants and offer yet another taxonomic perspective.

Concepts of species and application of names in the *Glandularia bipinnatifida* group have varied both widely and subtly. Details regarding some of the recent usage are discussed under the pertinent species. In general, Perry's study provided an excellent beginning but typological identifications blurred species boundaries. Even Umber's treatment of this group seems to have been marked by typology and over-inclusiveness, as he described segregates that I am not able to affirm and he overrepresented the morphological and geographical extent of *G. bipinnafida*. Turner nomenclaturally linked USA entities to a Mexican taxon, but my study indicates that the more northern species are discrete in morphology and geography, thus not calling for formal taxonomic connections with those further south.

To be complete, however, the present study would need to give detailed attention to the central Mexico representatives of the group, which have been abundantly collected. Umber (1979) and Peralta (1985) treated all of the Mexican plants of this group broadly as *Glandularia* (or *Verbena*) *bipinnatifida*, but there are geographical elements among them. *Verbena ciliata* Benth. [1839] = *Glandularia* (*Verbena*) *ciliata* (Benth.) Botta is the oldest name among the Mexican plants of this group.

In the present study, which centers on plants of the FNANM flora area, I have attempted to delimit taxa and their geographical distributions and then to find the correct names. An advantage of the protracted nature of this study (begun in 2008), looking and then looking again at various sets of specimens, is that discrete geographic boundaries have become more evident. Perception of ranges of variability also underlies, at least in part, differences with earlier studies in interpretation of nomenclatural types.

Glandularia racemosa (Eggert) Umber is perhaps a closely related member of this group, but its annual habit and small white corollas make it relatively simple to identify consistently. *Glandularia gooddingii* (Briq.) Solbrig produces leaves that vary from unlobed with merely toothed margins to leaves that are deeply dissected with linear lobes — the latter are sometimes confused with plants of the species treated here. *Glandularia racemosa* is included in the key but is not among the species described and mapped; identification of *G. gooddingii* is discussed in a separate section below.

KEY TO THE SPECIES

1. Calyces eglandular to sparsely glandular with sessile to subsessile glands.

2. Floral bracts shorter to longer than the calyces; corolla tubes 9–14 mm, limbs mostly 9–15 mm in diam.; central USA..... **Glandularia bipinnatifida**
2. Floral bracts shorter than the calyces; corolla tubes 7–13, limbs 6–10(–12) mm in diam.; Arizona and New Mexico.

3. Stems decumbent to ascending or ascending-erect, 12–40 cm; calyces 5–7 mm; corollas purplish to blue or lavender, tubes 7–11, limbs 6–9 mm in diam.; habitats at 1300–2500 m ..... **Glandularia latiloba**
3. Stems ascending to erect, 20–80 cm; calyces 8–10 mm; corollas usually pink to purplish pink, less commonly violet, tubes 10–13 mm, limbs 7–10(–12) mm in diam.; habitats at 2300–2800(–3000) m ..... **Glandularia chiricahensis**

1. Calyces densely stipitate-glandular.

4. Plants annual; corollas white, sometimes bluish tinged; corolla tubes 6–7.5 mm, limbs (5.5–)6–9 mm in diam. ..... **GLANDULARIA RACEMOSA**
4. Plants annual or perennial; corollas pink to purplish or blue; corolla tubes 7–15 mm, limbs 7–12 mm in diam.

5. Stems densely hirsute to pilose-hirsute or hirsutulous, at least some of the hairs deflexed; corollas consistently bright pink to purplish pink and drying similarly, tubes 12–15 mm, limbs 8–12 mm in diam. ..... **Glandularia pubera**
5. Stems stiffly hirsute with hairs spreading at right angles; corollas usually drying purple, purple to bluish or pinkish when fresh, tubes 7–12 mm, limbs 7–12 mm in diam.

6. Plants perennial; stems decumbent-ascending to ascending-erect or erect; leaves 1–2-pinnatifid, midstem ovate to lanceolate-ovate in outline, 2–4(–5) cm; corolla tubes 8–12 mm; western Texas to New Mexico and Colorado ..... **Glandularia wrightii**
6. Plants annual; stems procumbent to decumbent-ascending,; leaves 2–3-pinnatifid, midstem broadly ovate to deltate in outline, 1.5–3(–4) cm; corolla tubes 7–9 mm; south Texas (Rio Grande plains) ..... **Glandularia longidentata**

GLANDULARIA BIPINNATIFIDA (Nutt.) Nutt., Trans. Amer. Philos. Soc., n.s. 5: 184. 1836. *Verbena bipinnatifida* Nutt., J. Acad. Nat. Sci. Philadelphia 2: 123. 1821. **TYPE: USA. Arkansas**. [Red River], *T. Nuttall s.n.* (probable holotype: PH digital image!; isotype: GH). Umber (1979) indicated that he saw an isotype at NY, but I did not find one there nor is one included in the NY online type database.

Verbena demareei Moldenke, Amer. Midland Naturalist 24: 752. 1940. **TYPE: USA. Arkansas**. Clark Co.: P.O. Okolona, chalk and marl ditches, 350 ft, 30 Jun 1938, *D. Demaree 17198* (holotype: NY?; isotypes: GH, MO!, NY digital image!). The NY specimen that is pictured

online (NY 00138170) was annotated by Moldenke in 1941 as an isotype; Moldenke (1962, p. 210), however, noted that the holotype is deposited at NY.

Plants perennial, sometimes annual. **Stems** prostrate, decumbent, ascending, or ascending-erect, sometimes adventitiously rooting on the proximal decumbent portions, 5–30(–50) cm, moderately to densely hirsute, eglandular. **Leaves** ovate to broadly ovate in outline, membranaceous, blades 1.2–2 times longer than wide, 1–2-pinnatifid, 3-parted, or deeply incised, ultimate segments linear to oblanceolate, midstem 1–6 cm, hispid-hirsute to strigose or hirtellous, eglandular; petioles 5–15(–20) mm. **Inflorescence** elongating to 5–15(–20) cm in fruit; floral bracts shorter to longer than the calyces. **Calyces** 7–10 mm, hispid and strigose, eglandular or sometimes sparsely stipitate-glandular. **Corollas** purple, lavender, or bluish, rarely white, tubes 9–14 mm, limbs mostly 9–15 mm in diam. **Nutlets** cylindric, 2.5–3.2 mm, not broadened at the base, black, commissure not reaching the apex, 1/3–1/2 as wide as the nutlet apex, apical appendage absent. 2n = 30.

Flowering Apr–Jun(–Oct). Prairies, ridges, bluffs, limestone outcrops, gypsum hillsides, low woods, roadsides, fencerows; 50–600 m; Ala., Ark., Colo., Ga., *Ind., *Iowa, Kans., *Ky., La., Miss., Mo., Nebr., Okla., S.Dak., Tex., *Wis., Wyo.; Mexico (Coahuila). Map in Fig. 4. *=cultivated?

I have seen only two collections of *Glandularia bipinnatifida* sensu stricto from Mexico (as mapped here on Fig. 4): **Coahuila**: Mpio. Villa Acuña, limestone hill near Santo Domingo, 3 Jul 1936, *Wynd & Mueller 450* (MO); Mpio. Villa Acuña, Rancho El Rincon, on SW margin of Serranias del Burro (part of Sierra del Carmen), ca. 80 km SE of Big Bend Natl. Park, Texas, 1400-2100 m, 22 Jun 1991, *Ruiz 54* (TEX).

The Mississippi-Alabama plants consistently have minutely stipitate-glandular calyces (vouchers seen from Scott and Oktibbeha cos. — Miss; Autauga, Dallas, Greene, Hale, Lowndes, Marengo, Montgomery, Pickens, Sumter, Wilcox cos. — Ala). I have not seen a voucher for the extreme eastern outlyer in Georgia (Houston Co., see Fig. 4; ranked S1 by the Georgia Natural Heritage Program), but presumably it is similar to those in Alabama and eastern Mississippi. The population system east of the Mississippi River might be recognized at varietal rank, emphasizing its geographical distinction, but the sparse glandularity occurs sporadically through western populations and such a minor and quantitative distinction hardly seems to justify formal recognition.

Turner (1998, 1999) treated *Glandularia bipinnatifida* broadly to include several putatively intergrading geographic varieties. Within his concept of *G. bipinnatifida* var. *ciliata* (Benth.) Turner (= *Glandularia ciliata*) were three entities treated here as distinct species: *G. longidentata*, *G. wrightii*, and *G. pubera*. In the concept here, *Glandularia ciliata* sensu stricto is a species of central Mexico (southern Durango, Nayarit, and Jalisco eastward to San Luis Potosí, Hidalgo, Estado México, and Puebla) and does not appear to be genetically continuous with the more northern taxa.

Umber's concept of *Glandularia bipinnatifida* (1979, 1980) was even broader. Within it, he included *G. ciliata* sensu stricto and plants identified here as *G. latilobata*, *G. longidentata*, and *G. wrightii*. He was mostly unable to find any meaningful geographic trends in morphology, but he did, however, find "chemical races"(based on flavonoid profiles) that bear some correspondence to taxa recognized in the present study.

GLANDULARIA WRIGHTII (A. Gray) Umber, Syst. Bot. 4: 92. 1979. *Verbena wrightii* A. Gray, Synopt. Fl. N. Amer. 2: 337. 1878. **TYPE: USA. Texas.** [El Paso Co.: Franklin Mountains] Mountains near Fronteras, 22 Mar 1852, *C. Wright 1504* (holotype: GH! — Fig. 1 in the present report; isotypes: F digital image!, NY! digital image!; probable isotype: MO!).

Verbena ambrosiifolia Rydb. ex Small, Fl. S.E. U.S., 1011, 1327. 1903. **TYPE: USA. Colorado.** Otero Co.: Rocky Ford, 8 Jun 1900, *G.E. Osterhout s.n.* (holotype: NY!, digital image!).

Verbena wrightii forma *albiflora* Moldenke, Phytologia 11: 497. 1965. **TYPE: USA. Texas.** Brewster Co.: Alpine, Sul Ross College campus, 2 Apr 1936, *B.H. Warnock 44* (holotype: NY; isotype: US digital image!).

Plants perennial. **Stems** decumbent-ascending to ascending-erect or erect, (15–)25–60 cm, stiffly hirsute with hairs spreading at right angles, eglandular or very sparsely stipitate-glandular. **Leaves** ovate to lanceolate-ovate in outline, membranaceous, blades 1.2–2(–2.5) times longer than wide, 1–2-pinnatifid, ultimate segments mostly lanceolate to oblanceolate, midstem mostly 2–4(–5) cm, hirsute-strigose, eglandular; petioles 4–15 mm. **Inflorescence** elongating to 2–5(–11) cm, in fruit; floral bracts shorter than to nearly equalling the calyces. **Calyces** 6–8 mm, sparsely to moderately hirsute-pilose, densely minutely stipitate-glandular. **Corollas** mostly purple-pink, rose-purple, purple, or lavender-blue, tubes 8–12 mm, limbs 7–12 mm in diam. **Nutlets** cylindric, 2.5–3.2(–3.5) mm, slightly broadened at the base, black, commissure not reaching the apex, 1/3–1/2 as wide as the nutlet apex, apical appendage absent. $2n = 30$.

Flowering Apr–Sep. Creosote bush, creosote bush-acacia-mesquite, shrubland, juniper, pine-juniper, pine-juniper-oak, limestone slopes, grasslands, roadsides, fencerows, rocky hillsides, lava beds, gravelly banks, arroyos; 1300–2400 m; Colo., N.Mex., Tex.; Mexico (Chihuahua, Coahuila, Durango, Nuevo León, Zacatecas). *Glandularia wrightii* occurs in Oklahoma — in Cimarron Co., in the western tip of the panhandle. Map in Fig. 5.

In the interpretation here, the type specimen of *Glandularia wrightii* does not correspond to the morphological concept adopted by Umber (1979) and by Turner and Powell (2005). What they identified as *G. wrightii* is instead identified here as *G. pubera*. Measurements from the holotype of *G. wrightii* (Fig. 1): calyces 7–8 mm long, lobes linear-filiform; corollas "light purple" (fide A. Gray), tubes 8–11 mm long, limbs ca. 8–10 mm in diam., lobes 2.5–3.5 mm wide; floral bracts and calyces hirsute, densely stipitate-glandular; stems sparsely glandular, hirsute-hirsutulous, hairs spreading at right angles, 0.2–0.9 mm long.

The southern boundary of *Glandularia wrightii* is not determined with certainty in the present study. I have mapped the species as far south as northern Zacatecas (Fig. 5), where it apparently becomes sympatric with *G. ciliata*, but this needs detailed study and documentation. Turner saw only a single taxon, which he recognized as *G. bipinnatifida* var. *ciliata*; if his biological interpretation is correct, *Verbena ciliata* Benth. would be the oldest name for the species.

Glandularia wrightii along the eastern edge of its range is parapatric to slightly sympatric with typical *G. bipinnatifida* (Figs. 4, 5). The two taxa both a hexaploid and clearly are very similar in morphology but the differences (especially the vestiture) as outlined in the couplet below are consistent and sharply defined.

1. Inflorescence elongating to 2–5(–11) cm, in fruit; calyces sparsely to moderately hirsute-pilose, densely minutely stipitate-glandular; corolla tubes 8–12 mm, limbs 7–12 mm in diam.
..... **Glandularia wrightii**

1. Inflorescence elongating to 5–15(–20) cm in fruit; calyces hispid and strigose, eglandular or sometimes sparsely stipitate-glandular; corolla tubes 9–14 mm, limbs mostly 9–15 mm in diam.
..... **Glandularia bipinnatifida**

Turner (1998, p. 5) observed that *Glandularia bipinnatifida* "is relatively uniform over most of its distribution, but just west of the Pecos River in trans-Pecos Texas it appears to intergrade over a relatively short distance in [*G. wrightii*]. … Once the Pecos River is reached going eastward (only ca. 15 mi or so), the populations of [*G. wrightii*] are replaced by [*G. bipinnatifida*]." In Pecos County, where they are sympatric within about a 50-mile radius of Fort Stockton (west of the Pecos

River), intermediates have been noted between the two (*Turner 97-33*, *97-43*, *97-79*; all TEX); at other sites in the same area, they appear to grow together without intermediacy (e.g., *Turner 24-53*, typical *G. wrightii*, observed to be growing with typical *G. bipinnatifida*). Even in view of these hybrids in the narrow zone of sympatry/parapatry, the morphological distinction between the two appears to be essentially discontinous and in justification of their treatment as separate species. Still, it is a subjective judgement and their treatment as conspecific varieties also might be justified in view of the hybridization.

GLANDULARIA LONGIDENTATA (L.M. Perry) Nesom, comb. et stat. nov. *Verbena ciliata* Benth. var. *longidentata* L.M. Perry, Ann. Missouri Bot. Gard. 20: 331. 1933. **TYPE**: **Mexico**. **Tamaulipas**. Matamoros, Apr 1836, *J.L. Berlandier 3020* (holotype: MO!, digital image!; isotypes: GH!, NY-digital image!).

Plants annual. **Stems** branching profusely from crown, procumbent to decumbent-ascending, 1.5–3(–4) cm, pilose to hirsute or hispid-hirsute, eglandular. **Leaves** broadly ovate to deltate in outline, membranaceous, blades 1.5–2 times longer than wide, 2–3-pinnatifid, ultimate lobes lanceolate to oblanceolate, midstem 1.5–3(–4) cm, hirsute to hirsute-strigose, eglandular, rarely sparsely stipitate-glandular; petioles 4–10 mm. **Inflorescence** elongating to 2–5(–7) cm in fruit; floral bracts shorter than the calyces. **Calyces** 6–7 mm, hispid-hirsute, densely minutely stipitate-glandular. **Corollas** rose-lavender, blue-lavender, or purple to violet, tubes 7–9 mm, limbs 8–11 mm in diam. **Nutlets** subcylindric, 2.2–3.2 mm, broadened at the base, black, commissure not reaching the apex, 1/3–1/2 as wide as the nutlet apex, apical appendage absent. $2n = 30$ (as inferred from reports of counts of "*G. bipinnatifida*" from Duval and Hidalgo counties; Lewis & Oliver 1961).

Flowering Dec–Apr. Fields, vacant lots, roadsides, ditch banks, low hills, low plains, thorn scrub, saline flats, sand, sandy loam, silty clay, caliche, marl; 2–60(–500) m; Texas; Mexico (Nuevo León, Tamaulipas). Map in Fig. 6.

Glandularia longidentata is essentially parapatric with typical *G. bipinnatifida* (Figs. 6 and 4) but both species have been collected in Maverick, McMullen, Nueces, and San Patricio counties. I have not seen an unequivocal intermediate, though occurrence of hybrids would not be unexpected. The former is distinct in its annual duration, consistently decumbent-ascending stems and radiating from the base (producing a bowl-shaped habit), shorter, relatively broader, and more dissected leaves, and shorter corolla tubes.

Perry's concept of *Verbena ciliata* var. *longidentata* corresponds to the taxon treated here at specific rank. Umber (1979) did not recognize it as distinct, treating the name as a synonym of his broadly defined *Glandularia bipinnatifida*. Turner (1998) mapped the population system of *G. longidentata* as part of *G. bipinnatifida* var. *ciliata*, showing its distinct range in Texas — similar to the distribution shown here in Fig. 6 and (also as interpreted here) similar in its essential parapatry with typical *G. bipinnatifida*.

Collections examined from **Mexico**. **Nuevo León**. 2 mi N of Sabinas Hidalgo, sandy loam bottom, 26 Mar 1944, *Barkley et al. 14512* (MO); 16 km W of Sabinas Hidalgo, Villaldama road, among large rocks, 7 Apr 1962, *Dominguez & McCart 8263* (BRIT); 2 mi N of Sabinas Hidalgo, sandy loam bottom, 26 Mar 1944, *Heard et al. 14512* (TEX); Sabinas Hidalgo, 16 Aug 1937, *Kenoyer s.n.* (MO); 12 mi W of Monterrey, rock and gravel in xerophytic canyon, 27 Feb 1944, *Painter et al. 14281* (TEX); 16 mi S of Nuevo Laredo on Hwy 85, 19 Mar 1967, *Wilson 12167* (TEX). **Tamaulipas**. 22 mi S of Matamoros, black clay, 21 Mar 1964, *Montemayor 31* (BRIT, TEX); 22 mi S of Matamoros, Natl. Hwy 101, sandy soil, 21 Mar 1964, *Serna 34* (BRIT).

GLANDULARIA LATILOBATA (L.M. Perry) Nesom, comb. et stat. nov. *Verbena bipinnatifida* Nutt. var. *latilobata* L.M. Perry, Ann. Missouri Bot. Gard. 20: 325. 1933. *Glandularia bipinnatifida* (Nutt.) Nutt. var. *latilobata* (L.M. Perry) B.L. Turner, Lundellia 2: 63. 1999. **TYPE: Mexico. Sonora**. Between San Pedro and Fronteras, 20-24 Sep 1890, *C.V. Hartman 906* (holotype: GH!).

Plants perennial. **Stems** decumbent to ascending or ascending-erect, 12–40 cm, hirsute and hirtellous, eglandular or sparsely stipitate-glandular. **Leaves** ovate to obovate in outline, membranaceous, blades 1.3–2 times longer than wide, 1–2-pinnatifid, ultimate lobes linear to oblanceolate, midstem 2–4 cm, hirsute to strigose-hirsute, eglandular or very sparsely stipitate-glandular; petioles 4–10 mm. **Inflorescence** elongating to 2–4(–6) cm in fruit; floral bracts shorter than the calyces. **Calyces** 5–7 mm, hirsute and strigose, eglandular to sparsely sessile to subsessile glandular. **Corollas** purplish to blue or lavender, tubes 7–11, limbs 6–9 mm in diam. **Nutlets** subcylindric, 2.5–3.2, broadened at the base, black, commissure not reaching the apex, 1/3–1/2 as wide as the nutlet apex, apical appendage absent. 2n = unknown.

Flowering (Apr–)Jun–Sep. Pinyon-juniper, pine-oak, oak, alluvial benches, roadsides; 1300–1800(–2300) m; Ariz., N.Mex.; Mexico (Chihuahua, Durango, Sonora). Map in Fig. 7.

Calyces of *Glandularia latilobata* characteristically appear eglandular but close inspection may show the presence of minute, translucent, sessile to subsessile glands. Arizona plants with stipitate glands and tentatively identified as *G. latilobata* should be reexamined for the possibility that they are instead *G. gooddingii* with dissected leaves. In Socorro Co., New Mexico, where *G. latilobata* is sympatric with *G. wrightii* (with densely stipitate-glandular calyces), the contrast in vestiture usually provides good confidence in their distinction. The flowers of *G. wrightii* also are larger than those of *G. latilobata* although the differences are overlapping.

Umber (1979) treated this entity among many synonyms of *Glandularia bipinnatifida* var. *pinnatifida*, while Turner (1999) followed the earlier observation of Perry and recognized it as *G. bipinnatifida* var. *latilobata* (although he broadened the concept by including *G. chiricahuensis* as a synonym). With Perry and Turner, I agree that "latilobata" is distinct, but its distribution (Fig. 7) is disjunct from that of typical *G. bipinnatifida*. At the southern end of its distribution in Mexico, *G. latilobata* apparently is sympatric with the Mexican endemic *G. ciliata*.

Turner's rationale for treating *Glandularia latilobata* as conspecific with *G. bipinnatifida* was explicit (p. 64): "This taxon is similar to [*G. bipinnatifida*] var. *ciliata* but lacks the glandular pubescence of that taxon. It grades into var. *ciliata* to the south and southeast." His distribution map, however, shows only a single intermediate symbol where their ranges contact, and my own observations suggest that they do not intergrade to the extent that would indicate their appropriate treatment as conspecific.

GLANDULARIA CHIRICAHENSIS Umber, Syst. Bot. 4: 92. 1979. **TYPE: USA. Arizona**. Cochise Co.: Chiricahua Mountains, Rustler's Park, 19 Aug 1973, *R. Umber 640* (holotype: GH!; isotypes: ARIZ, MO!, NMC, NY, UC).

Verbena ambrosiifolia Rydb. ex Small forma *eglandulosa* L.M. Perry, Ann. Missouri Bot. Gard. 20: 331. 1933. **TYPE: USA. New Mexico**. Grant Co.: vicinity of Silver City, Fort Bayard, Santa Rita, Fierro, the Mimbres Valley and East Canyon tributary to it, and on the G.O.S. Ranch, in canyons within 10 mi of the ranch house, Hannover [lft], 1 Aug 1911, *J.M. Holzinger s.n.* (holotype: MO!).

Plants perennial. **Stems** ascending to erect, 30–80 cm, hirsute-villous with flattened hairs, eglandular. **Leaves** ovate to broadly ovate in outline, membranaceous, blades 1.2–2 times longer than

wide, usually 1–2(–3)-pinnatifid, ultimate segments lanceolate to oblanceolate, midstem 3.5–7 cm, strigose on both surfaces; petioles 5–15 mm. **Inflorescence** elongating only slightly in fruit to 2–4(–5) cm; floral bracts slightly shorter to longer than the calyces. **Calyces** 8–10 mm, hirsute and strigose, eglandular or less commonly sparsely minutely stipitate-glandular. **Corollas** usually pink to purplish pink, less commonly violet, tubes 10–13 mm, limbs 8–11 mm in diam. **Nutlets** cylindric, 2.5–3.4 mm, not broadened at the base, black, commissure not reaching the apex, 1/3–1/2 as wide as the nutlet apex, apical appendage absent. 2n = 20 (Umber 1979).

Flowering Jun–Sep. Pine, pine-oak, pine-oak-birch, clearings, subalpine meadows, disturbed areas; 2200–2800(–3000) m; Ariz, N.Mex. Map in Fig. 8.

Glandularia chiricahensis is a distinct species recognized by its relatively tall, erect stems, short fruiting spikes, and eglandular calyces. The corollas commonly are relatively large and usually bright pink, similar to the characteristic corolla color in *G. pubera* (sometimes also seen in *G. gooddingii*. The flavonoid profiles of *G. chiricahensis* and *G. pubera* are essentially identical (Umber 1980) and they share a tetraploid chromosome number — perhaps evidence of close common ancestry and distinction as a pair apart from the hexaploids of the group (*G. bipinnatifida*, *G. wrightii*, *G. longidentata*, and probably *G. latilobata*).

Glandularia chiricahensis apparently is restricted to relatively high-elevation habitats in central to southeastern Arizona and adjacent New Mexico (Fig. 8). Additional collections examined (see type of *Verbena ambrosiifolia* forma *eglandulosa*, cited above) from New Mexico: **Grant Co.**: S end of the Black Range, Mimbres River, ca. 5500 ft, 20 Aug 1904, *Metcalfe 1231* (TEX); Redstone [ca. 20 km NNE of Silver City], 13 Aug 1895, *Mulford 896* (MO); mts. near Pinos Altos [ca. 11 km NNE of Silver City], 26 Jun 1936, *Stewart s.n.* (MO); just N of jct Hwy 90 and 61 at San Lorenzo, juniper zone, 14 Aug 1973, *Umber 625* (TEX). **Hidalgo Co.**: Peloncillo Mts, Clanton Canyon, ca. 2 mi below (east of) summit, Coronado Natl. Forest, 19 Aug 1952, *Tucker 2441* (LL); 9 mi NW of jct US 70 and US 90 on Hwy 90 Lordsburg, 15 Aug 1973, *Umber 631* (TEX).

GLANDULARIA PUBERA (Greene) Nesom, comb. nov. *Verbena pubera* Greene, Pittonia 5: 136. 1903. *Verbena ciliata* Benth. var. *pubera* (Greene) L.M. Perry, Ann. Missouri Bot. Gard. 20: 332. 1933. **TYPE**: **USA. Texas**. Jeff Davis Co.: Davis Mountains, 28 Apr 1902, *S.M. Tracy and F.S. Earle 337* (holotype: ND-G digital image!, Fig. 2 of the present report). *Tracy & Earle 162* has been cited or notated as the type, but the group of "162" duplicates instead constitutes a set of paratypes: **Texas**. Jeff Davis Co.: Davis Mts., 23 Apr 1902, *Tracy & Earle 162* (F digital image!, MO-2 sheets!, MO digital image!, ND-G digital image! Fig 2 of present report, NY digital image!, US digital image!). *Tracy & Earle 162a* (Fig. 3 of present report) also is a paratype.

Glandularia bipinnatifida (Nutt.) Nutt. var. *brevispicata* Umber, Syst. Bot. 4: 89. 1979. *Verbena bipinnatifida* Nutt. var. *brevispicata* (Umber) Moldenke, Phytologia 45: 470. 1980. **TYPE**: **USA. New Mexico**. Otero Co.: Mountain Park, yard of Trinity Baptist Church, corollas pink-purple, flowers with an acrid smell, [no date], *R. & J. Umber 607* (holotype: GH; isotypes: ARIZ, MO! MO-digital image!, NY-2 sheets-digital images!). This collection is the voucher for a chromosome count of $2n = 30$ (Umber 1979). At NY (00137539) and TEX (00375018 and 00375019) are specimens labeled by Umber as his collection 607 and annotated by him as "isotype," but they have slightly different label information from the protologue and from specimens with label data corresponding exactly to the protologue: "Abundant on the rocky, somewhat sandy hillsides in Mountain Park, New Mexico. This collection just NE of Trinity Baptist Church, not fragrant, viscid. Strong perennial." These variants should be regarded as paratypes.

Plants strongly perennial. **Stems** erect to ascending-erect, 15–40 cm, densely hirsute to pilose-hirsute or hirsutulous, at least some of the hairs prominently deflexed, eglandular. **Leaves** ovate to obovate in outline, membranaceous, blades 1–2 times longer than wide, 1–2(–3)-pinnatifid, ultimate segments oblong-lanceolate to lanceolate, midstem 4–5 cm, hirsutulous to strigose-hirsute, eglandular; petioles 3–7 mm. **Inflorescence** elongating to (2–)3–6 cm in fruit; floral bracts slightly shorter than the calyces. **Calyces** 8–10 mm, softly hirtellous, densely minutely stipitate-glandular. **Corollas** magenta to pink, tubes 12–15 mm, limbs 8–12 mm in diam. **Nutlets** subcylindric, 2.6–3.2 mm, slightly broadened at the base, black, commissure not reaching the apex, 1/2 as wide as the nutlet apex, apical appendage absent. $2n = 20$ (Turner & Powell 2005; Umber 1979, identified as *G. wrightii*; Lewis & Oliver 1961, identified as *G. wrightii*); $2n = 30$ (Umber 1979, identified as *G. bipinnatifida* var. *brevispicata*).

Flowering Feb–Aug. Rocky hillsides, rolling grassland, open oak woodland, pine-juniper, lava flows, road shoulders and embankments; (800–)1400–2300 m; Ariz., N.Mex., Tex.; Mexico (Chihuahua, Coahuila). Map in Fig. 9.

Glandularia pubera in the concept of the present study includes plants identified as *G. wrightii* by Umber (1979, p. 92), who noted that he was "applying the name *Glandularia wrightii* to those tetraploid populations [in trans-Pecos Texas] with an erect habit, compact spikes in flower and in fruit, a viscid inflorescence, and soft grayish leaves which form an acute angle with the stem." Turner and Powell's morphological concept of *G. wrightii* (2005) was essentially the same as Umber's but as observed here, that name has been incorrectly applied.

The description of *Glandularia bipinnatifida* var. *brevispicata* by Umber (1979) and his concept of it also are a close fit to the trans-Pecos Texas plants that he identified as *G. wrightii* (here = *G. pubera*). Umber observed (pp. 90–91) that var. *brevispicata* is "Easily recognized by its abbreviated congested spikes, short calyx teeth, viscid inflorescence, tall, erect or strongly ascending habit, and pink-purple flowers with tubes that are at least twice as long as the calyx." He also noted that "The fragrance of the flowers is not at all pleasant, unlike the usually sweet fragrance of the type variety [here = *G. wrightii*]… [but instead] reminiscent of an acrid chemical smell" — the fragrance is not diagnostic, however, as the holotype was observed to have a resinous smell while paratypes from very near the type locality were without any fragrance (as observed by Umber). Umber's key (p. 86) distinguished var. *brevispicata* by its corolla tubes 2–2.5 times longer than the calyx (vs. 1.5–2 times longer in *G. pubera*) and calyx lobes ca. 1 mm long (vs. 1.5–3.5 mm long in *G. pubera*), but these differences are not consistent.

Umber noted (1979, p. 91) that *Glandularia bipinnatifida* var. *brevispicata* is "primarily found in mountains and high plateaus of New Mexico, northeastern Arizona, and northern Mexico" (Coahuila and Nuevo León on his Figure 7 of 1979; his Fig. 3 of 1980). Remarkably, he mapped the populations of *G. wrightii* (here identified as *G. pubera*) as interposed directly between the New Mexico/Arizona populations and the Mexico populations of var. *brevispicata*. Umber's var. *brevispicata* and his *G. wrightii* are essentially identical in flavonoid profiles (Umber 1980), and the present study interprets all of these plants as representing a single evolutionary entity, identified here as *G. pubera* (Fig. 9).

Chromosome number of *Glandularia pubera*.

Turner (1998) included *Glandularia pubera* within his broad concept of *G. bipinnatifida* var. *ciliata*. Later, he and Powell (Turner & Powell 2005, p. 1660) recognized it as distinct, observing that in trans-Pecos Texas it "often grows in close proximity to *G. bipinnatifida* [here = *G. wrightii*] without showing signs of hybridization." Turner and Powell found that the two entities in that area also are distinct in ploidy level, with *G. pubera* consistently tetraploid ($2n = 20$, 4 populations

counted from 3 counties), while *G. wrightii* is consistently hexaploid (2*n* = 30, 18 populations counted from 7 counties) — confirmed here from vouchers at TEX.

The voucher for a tetraploid count, 2*n* = 20, from Apache Co., Arizona (Lewis & Oliver 1961) was identified by Umber as as *Glandularia bipinnatifida*. It seems likely that this was a plant of *G. pubera* in the present sense; I have not seen the voucher. The voucher for a tetraploid count, 2*n* = 20, from Apache Co., Arizona (ENE of Springerville on US 60, 4 Aug 2001, *Windham 2530*, MO!) is unequivocally a plant of *Glandularia pubera*.

Two inconsistencies are noted. (1) The voucher for a hexaploid count (Brewster Co., Texas, *Turner 24-159*, TEX; reported by Turner and Powell 2005) is a plant of typical *Glandularia pubera*. A duplicate of 24-159 at SRSC, however, is *G. wrightii* in the present sense (fide Mike Powell, pers. comm.) and more likely represents the species from which the chromosome sample originated. (2) Umber reported the chromosome number of the type collection of *G. bipinnatifida* var. *brevispicata* as hexaploid; this was the only count he reported from among the plants he identified as var. *brevispicata*. If Umber's count is correct and correctly vouchered, it documents the only record of a hexaploid within *G. pubera*, which otherwise apparently is composed of tetraploid populations.

Identification of *Glandularia gooddingii*.

Glandularia gooddingii in its typical form, with unlobed leaf margins, is easy to identify correctly. The combination of short floral bracts, densely stipitate-glandular calyces, short calyx lobes, and broad corolla limbs (10–14 mm in diam.) also is diagnostic. In Arizona, variants of *G. gooddingii* with deeply divided leaves and linear ultimate segments often are confused in identification with species of the *G. bipinnatifida* group — they are contrasted here. *Glandularia gooddingii* is currently documented unequivocally from New Mexico by only one collection from Hidalgo Co. (Nesom 2010).

1. Calyces eglandular or nearly so.

    2. Calyces 5–7 mm; corolla tubes 7–11, limbs 6–9 mm in diam., purplish to blue or lavender ..... **Glandularia latilobata**
    2. Calyces 8–10 mm; corolla tubes 10–13 mm, limbs 8–11 mm in diam., usually pink to purplish pink, less commonly violet ..... **Glandularia chiricahensis**

1. Calyces prominently stipitate-glandular.

    3. Calyces (5–)6–7(–8) mm; corolla tubes 8–10 mm, limbs 10–14 mm in diam.; leaves commonly with 3 main divisions ..... **Glandularia gooddingii**
    3. Calyces 8–10 mm; corolla tubes 12–15 mm, limbs 8–12 mm in diam.; leaves usually pinnatifid ..... **Glandularia pubera**

Glandularia gooddingii (Briq.) Solbrig, Madroño 15: 50. 1959. *Verbena gooddingii* Briq., Annuaire Conserv. Jard. Bot. Genève 10: 103. 1907. *Verbena bipinnatifida* var. *gooddingii* (Briq.) Jepson, Fl. Calif. 3: 382. 1943. **TYPE: USA. Nevada**. [Lincoln Co.]: Kernan, Meadow Valley Wash, sandy bottoms, 28 Apr 1902, *L.N. Goodding 645* (holotype: G-DEL; isotypes: F digital image!, GH, MO! digital image!, POM, RM, US digital image!).

Verbena gooddingii var. *nepetifolia* Tidestrom, Proc. Biol. Soc. Wash. 38: 15. 1925. **TYPE: USA. Nevada**. Lincoln Co.: El Dorado Cañon, near Colorado River, 600 m, 2 May 1919, *I. Tidestrom 8835* (holotype: US digital image!).

Plants perennial. **Stems** erect, basally ascending, 10–40 cm, pilose-hirsute, stipitate-glandular at least on the distal half, uncommonly eglandular. **Leaves** deltate to ovate or broadly ovate

in outline, membranaceous, blades 1.5–2 times longer than wide, incised to coarsely toothed with deltate to triangular teeth, ultimate segments deltate to ovate or lanceolate, to deeply divided with ultimate segments sublinear, midstem 2–5 cm, hirsute-strigose to strigose adaxially, hirsute abaxially, eglandular to very sparsely stipitate-glandular; petioles 3–10 mm. **Inflorescence** mostly remaining compact, elongating to 2–5(–8, –10) cm in fruit; floral bracts 1/2–3/4 as long as the calyces. **Calyces** (5–)6–7(–8) mm, densely minutely stipitate-glandular, pilose-hirsute, lobes 0.5–1 mm, shallowly deltate to triangular-deltate or triangular, usually apiculate. **Corollas** pink to purple or lavender, tubes 8–10 mm, limbs 10–14 mm in diam. **Nutlets** cylindric, 2.5–3(–3.5) mm, not broadened at the base, black, commissure not reaching the apex, 1/3–1/2 as wide as the nutlet apex, apical appendage absent. 2n = 30.

Flowering (Feb–)Mar–Jun (–Dec, sporadically). Talus, flats, hillsides, sandy ridges and bottoms, washes, river banks, streambeds, desert grassland, rocky slopes, roadsides, canyon bottoms, brittlebrush-tamarisk, oak, thornscrub, pinyon-juniper, ponderosa pine-juniper, oak-juniper-hackberry, oak chaparral, baccharis-mesquite-Chilopsis, oak-ash, *Larrea-Yucca-Fouquieria-Opuntia*, *Washingtonia*; 400–1500(–2000) m; Ariz., Calif., N.Mex., Nev., Utah; Mexico (Baja California, Sonora).

ACKNOWLEDGEMENTS

I am grateful to staff at MO, SMU-BRIT, TEX-LL, and UNM, where collections of *Glandularia* were studied and annotated on site, to UNM for a loan of specimens (to TEX), to staff at GH for sending specimens and digital images of critical specimens, to Barbara Hellenthal at ND for sending digital images and observations on the type of *G. pubera*, and to Bill Weber for reviewing the Colorado collections of *Glandularia* at COLO. I am grateful to Mike Powell for comments on the manuscript and to Billie Turner for his continuing interest in *Glandularia*, his comments on the manuscript, and his always-ready willingness to look from a different perspective. I also thank Jim Henrickson for his opinions on *Glandularia* taxonomy and a copy of his preliminary manuscript and notes (ca. 2008) dealing with the *G. bipinnatifida* complex — and look forward to the completion of his study, which includes an assessment of the Mexican plants. Dr. Henrickson and I agree on delimitation of some of the entities, but the nomenclature here does not correspond with what he has proposed and the new names proposed here do not preempt those in his taxonomy. We disagree variously (fide his preliminary manuscript) with respect to the rank at which taxa should be recognized, choice of types, and the placement of synonyms. The present study has been supported in part under contract from the Flora of North America Association, in conjunction with preparation of the taxonomic treatment of Verbenaceae for FNANM.

LITERATURE CITED

COLO Specimen Database. 2010. Specimen Database of Colorado Vascular Plants. Univ. of Colorado Museum of Natural History, Boulder. <http://cumuseum.colorado.edu/Research/Botany/Databases/search.php>

Lewis, W.H. and R.C. Oliver. 1961. Cytogeography and phylogeny of the North American species of *Verbena*. Amer. J. Bot. 48: 638–643.

Moldenke, H.N. 1961. Verbenaceae. Pp. 13–87, in Flora of Texas, Vol. 3. Texas Research Foundation, Renner, Texas.

Moldenke, H.N. 1962–1965. Materials toward a monograph of the genus *Verbena*. *Verbena ambrosiifolia*: (II) Phytologia 8: 149–152. 1962. *Verbena bipinnatifida*: (III) Phytologia 8: 207–216. 1962 and (IV) 8: 230–244. 1962. *Verbena ciliata*: (IX) Phytologia 9: 12–29. 1963. *Verbena demareei*: (III) 8: 175–216. 1962. *Verbena wrightii*: (XXIX) Phytologia 11: 486–498. 1965.

Moldenke, H.N. 1980. A sixth summary of the Verbenaceae, Avicenniaceae, Stilbaceae, Chloanthaceae, Symphoremaceae, Nyctanthaceae, and Eriocaulaceae of the world as to valid

taxa, geographic distribution and synonymy. Phytologia Mem., Vol. 2. Plainfield, New Jersey.

Nesom, G.L. 2010 (to be published). *Glandularia gooddingii* (Verbenaceae) in New Mexico. Phytoneuron.

Peralta, B.L.C. 1985. *Verbena* L. Pp. 286–290 in J. Rzedowski and G.C. Rzedowski. Flora Fanerogámica del Valle de México, Vol. II, Dicotyledoneae (Euphorbiaceae-Compositae). Publ. 15, Instituto de Ecología, México, D.F.

Perry, L.M. 1933. A revision of the North American species of *Verbena*. Ann. Missouri Bot. Gard. 20: 239–356.

Turner, B.L. 1998. Texas species of *Glandularia*. Lundellia 1: 3–16.

Turner, B.L. 1999. A reevaluation of the Mexican species of *Glandularia* (Verbenaceae). Lundellia 2: 55–71.

Turner, B.L. and A.M. Powell. 2005. Chromosome numbers of *Glandularia* (Verbenaceae) from central and trans-Pecos Texas. Sida 21: 1657–1661.

Umber, R.E. 1979. The genus *Glandularia* (Verbenaceae) in North America. Syst. Bot. 4: 72–102.

Umber, R.E. 1980. The flavonoid chemistry of *Glandularia bipinnatifida* (Verbenaceae) and allied species. Amer. J. Bot. 67: 935–941.

Figure 1. Holotype of *Glandularia* (Verbena) *wrightii*, *Wright 1504*, GH.

Figure 2. Holotype of *Verbena pubera*, *Tracy & Earle 337*, ND-Greene — top two plants. Paratype of *Verbena pubera*, *Tracy & Earle 162* — bottom plant.

Figure 3. Paratype of *Glandularia* (Verbena) *pubera*, *Tracy & Earle 162a*, ND-Greene (see text).

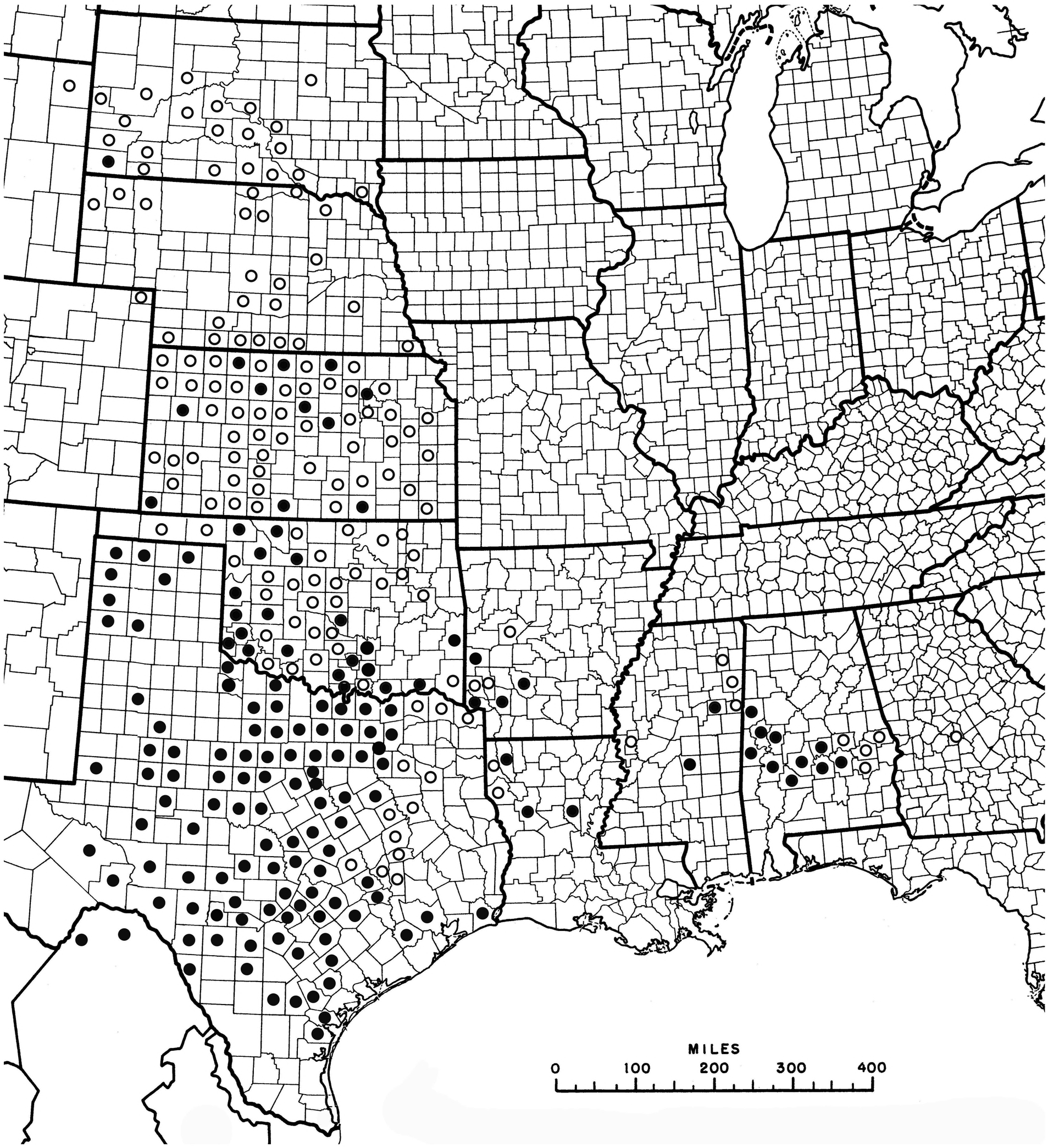

Figure 4. Distribution of *Glandularia bipinnatifida*. Open circles are records from literature, vouchers not seen.

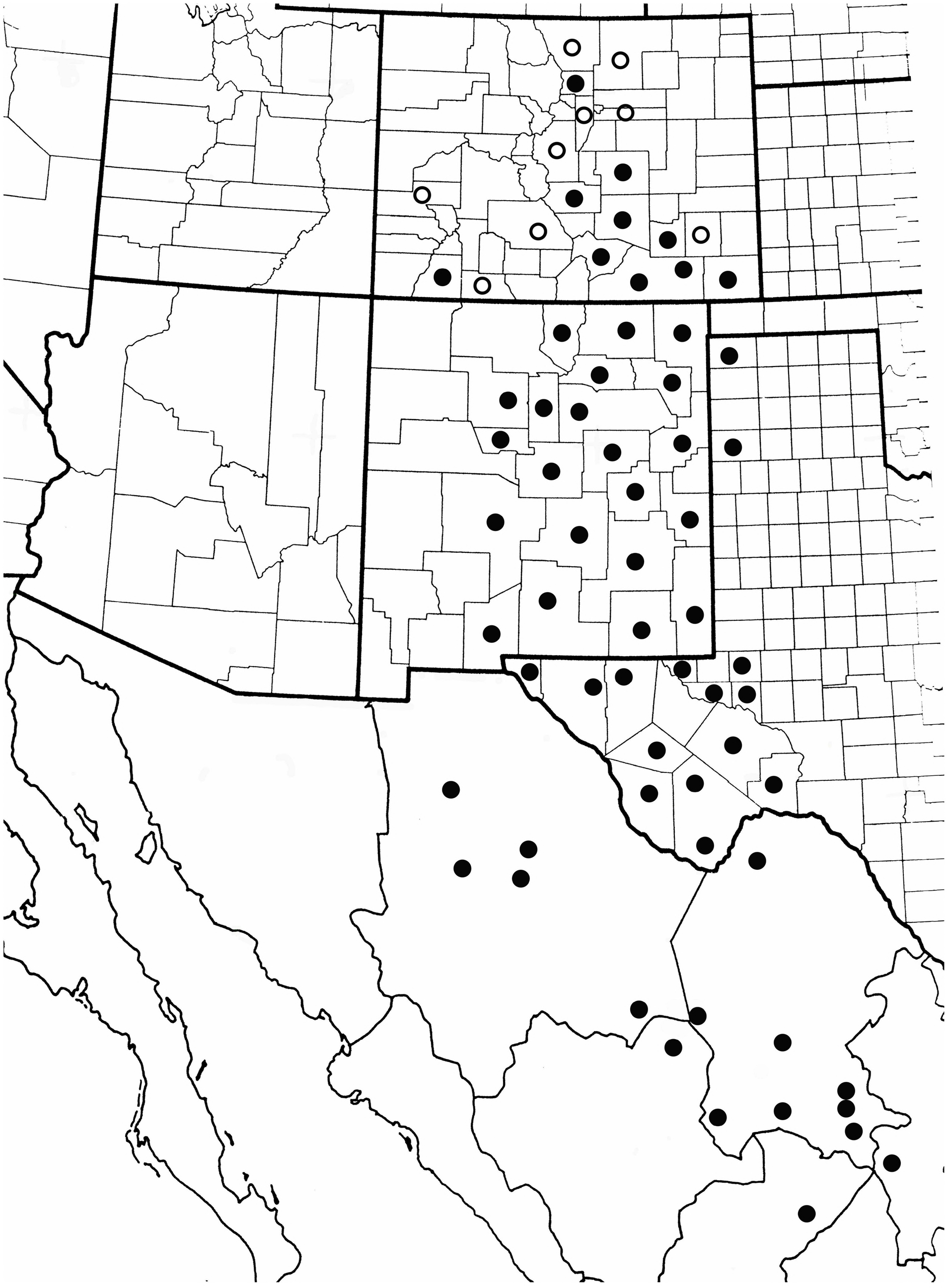

Figure 5. Distribution of *Glandularia wrightii*. Open circles are from the COLO Specimen Database (2010), vouchers not seen in the present study.

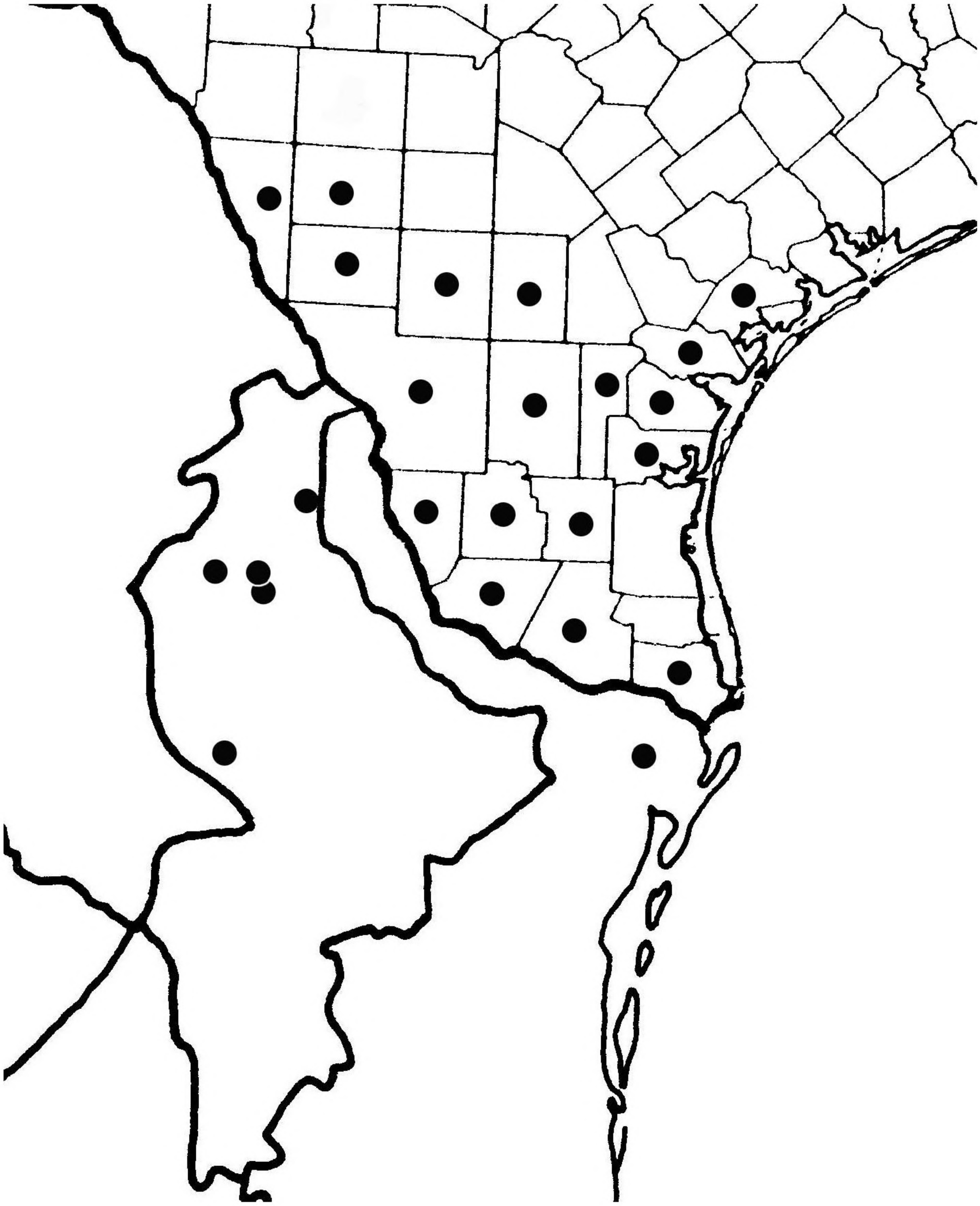

Figure 6. Distribution of *Glandularia longidentata*.

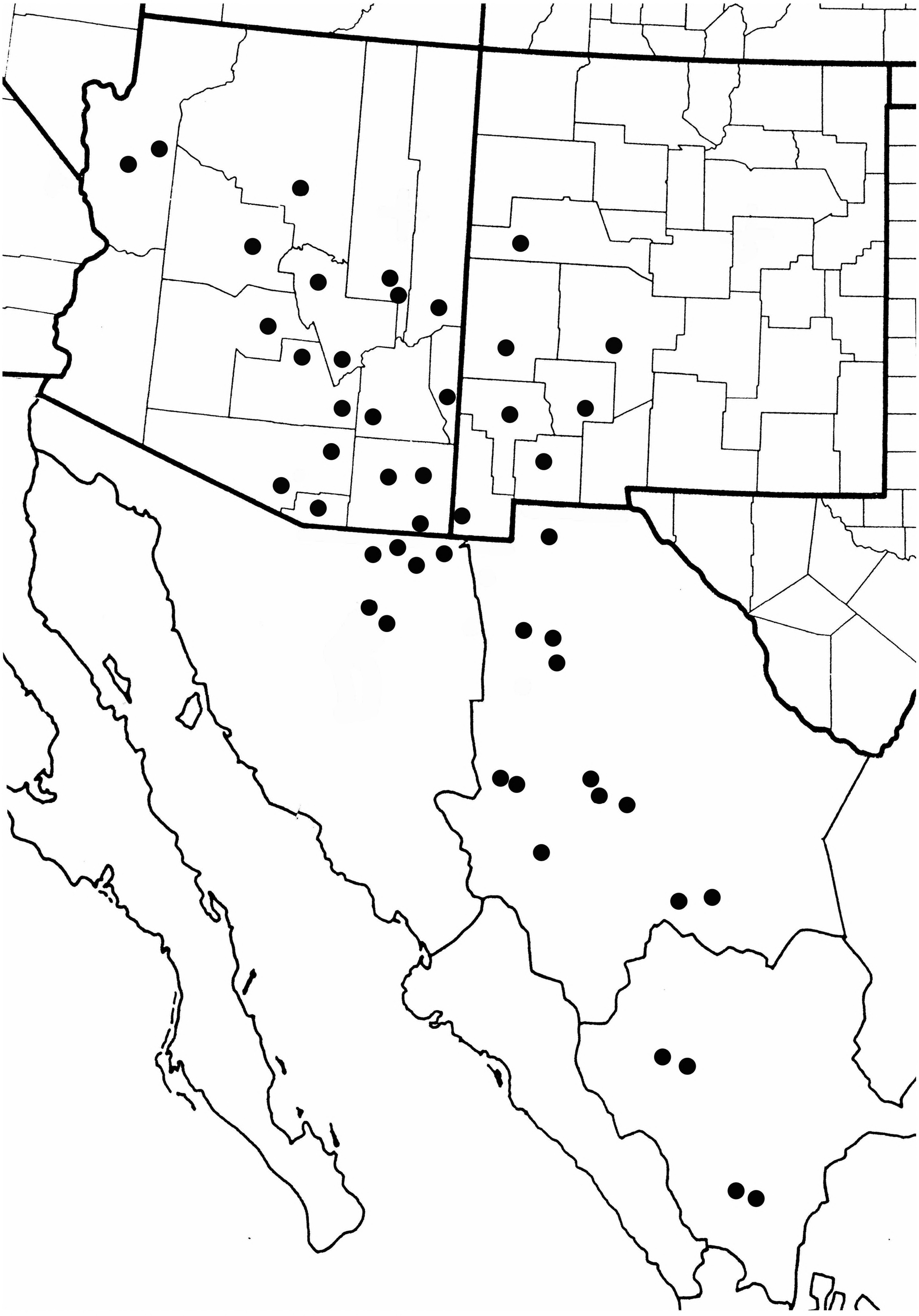

Figure 7. Distribution of *Glandularia latilobata*.

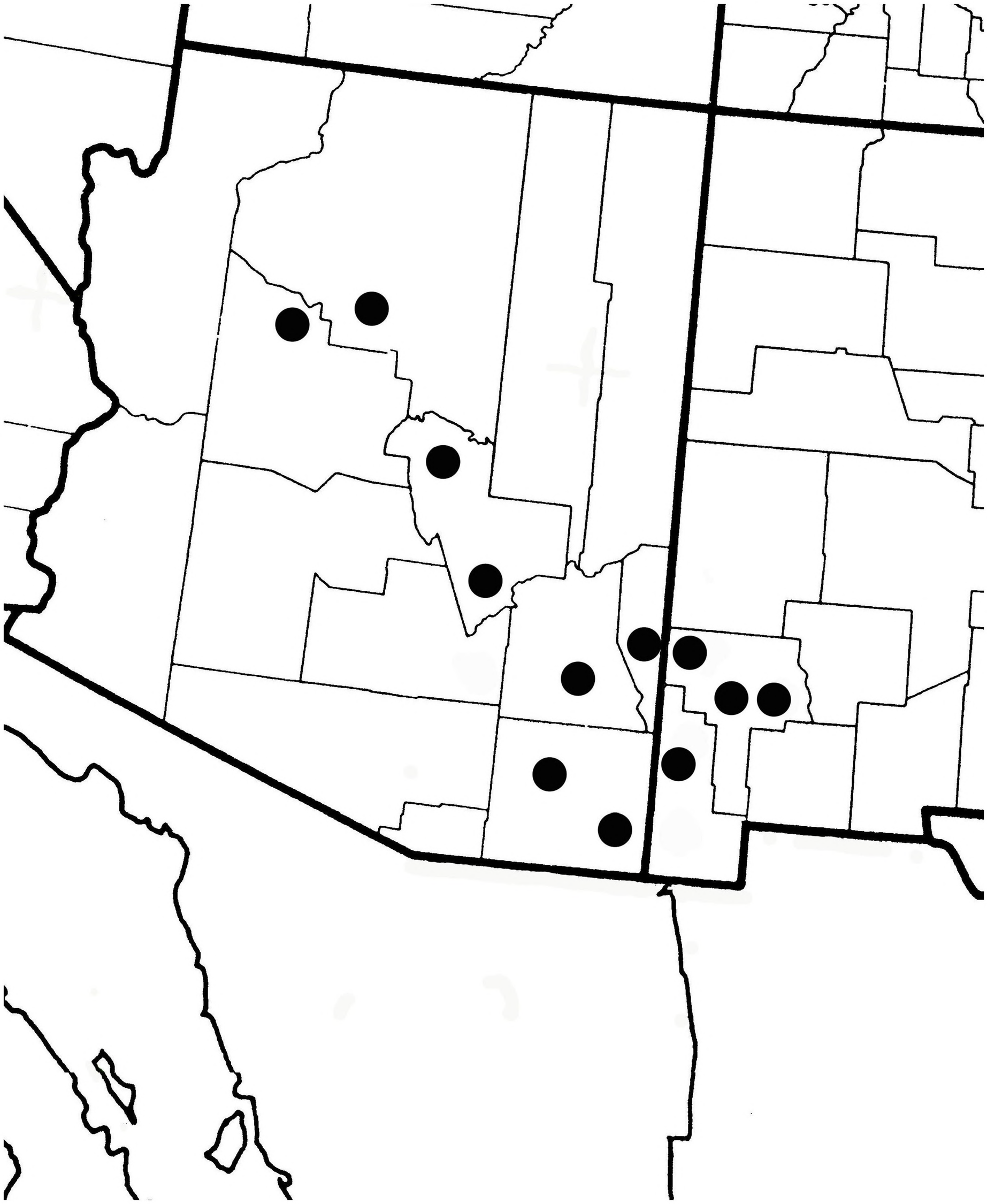

Figure 8. Distribution of *Glandularia chiricahensis*.

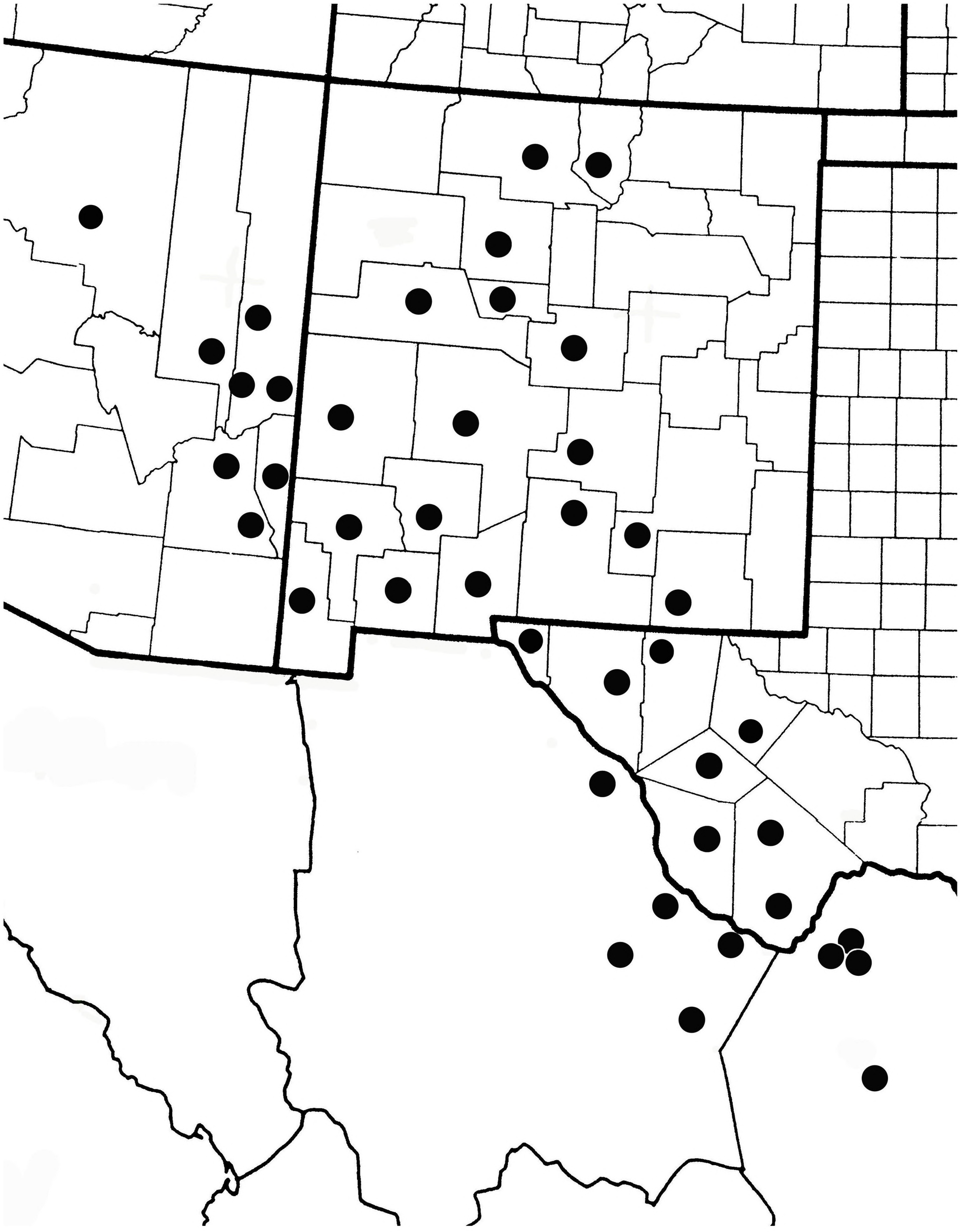

Figure 9. Distribution of *Glandularia pubera*.